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TESTING DEVICE FOR MOTOR VEHICLE CRASH SIMULATION

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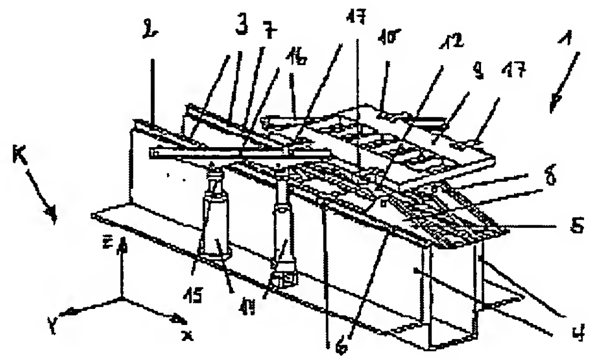
[Abstract]

For a testing device for motor vehicle crash simulation, with first and second sled arrangements that are arranged one on top of the other, are hinged together, and can move horizontally along a rail arrangement, a test assembly arranged on the second sled arrangement with the motor vehicle components to be tested, a first acceleration device, by means of which

acceleration forces that can be preset in the y-direction [sic; z-direction] can be transferred to the second sled arrangement, and a second acceleration unit, by means of which an acceleration that can be preset in the x-direction can be transferred to the sled arrangement, shall simulate a rotational motion in order to improve the motion in pitch of the vehicle. This is achieved in that the first acceleration unit (13) is supported exclusively between a foundation and the second sled arrangement (9).



[0001]

The invention relates to a testing device for motor vehicle crash simulation according to the preamble of Claim 1.

[0002]

Ever shorter development times in automobile production and the demand for superior passive safety systems have led to the development and construction of testing devices for crash simulation, which are also called servo-hydraulic catapult systems.

[0003]

For inverse crash tests, i.e., the reversal of deceleration and acceleration, vehicle components, such as seats, steering-wheel columns and steering wheels, windshields, dashboards, safety belts and their attachments, airbag systems, and other components are controlled and accelerated according to various accident situations in a reinforced vehicle chassis, the so-called tank body, on a sled, and the failure behavior or component safety is examined. The acceleration is here applied by a servo-cylinder as a control element. The servo-cylinder is controlled by a four-stage servo-valve which connects to a piston-type accumulator unit. Such a servo-hydraulic catapult system is known, e.g., from a factory newsletter RIQ, edition 1/1998, pp. 2-4 from Mannesmann-Rexroth.

[0004]

A testing device for vehicle crash simulation is known from DE 198 57 429 A1. This device features a horizontal sled arrangement which can move along a rail arrangement. The test assembly is provided with the vehicle components to be tested on the sled arrangement. The device is further equipped with a first acceleration unit which can transfer a predetermined acceleration to the sled arrangement. In order to improve the simulation of accident situations, a second acceleration unit is provided which can transfer predetermined acceleration forces in the vertical direction to the sled arrangement. The introduction of vertical acceleration forces to the sled arrangements also permits the simulation of rotational motion of the vehicle about the transverse axis (pitching), which occurs during rear-end collisions. The angle produced by such a rotation about the transverse axis is called the pitch angle (DIN 7000).

[0005]

The problem of the present invention is to further improve such a testing device for motor vehicle crash simulation, which permits the simulation of a rotational movement about the transverse axis of the vehicle.

[0006]

This problem is solved in that the second acceleration unit is supported exclusively between a foundation and the second sled arrangement.

[0007]

For the testing device according to the invention, all hydraulic cylinders of the second acceleration unit are supported on a foundation on one side and on the carrier sled on the other side. In contrast to the closest prior art, the arrangement of a hydraulic cylinder on the first sled arrangement (base sled) can be eliminated from DE 198 57 429 A1 mentioned in the introduction of the description. This has the decisive advantage that the oil supply, accumulator, lines, etc., for the hydraulic cylinder no longer have to be arranged on the sled arrangement and likewise accelerated simultaneously. The first sled arrangement thus features a considerably lower weight, so that the acceleration forces necessary for the test sequence can be achieved.

[0008]

Another advantage is the formation of the first and second sled arrangements, i.e., the base sled and the carrier sled are coupled to each other via connecting elements, e.g., lever arrangements. This method essentially prevents a transfer of transverse forces to the hydraulic cylinder of the second acceleration unit.

[0009]

In one refinement of the concept according to the invention, the side guidance rails are split in two, and thus one guidance rail is allocated to each hydraulic cylinder of the second acceleration unit. Through this configuration, the test assembly arranged on the carrier sled remains on a center-of-gravity line for any arbitrary rotation about the y-axis.

[0010]

Additional advantageous features as well as the function of the invention are apparent from the following description of embodiments, with reference to the drawing.

[0011]

Shown are:

[0012]

Figure 1a, an oblique view of a structural variant of the testing device according to the invention;

[0013]

Figure 1b, a side view of the testing device according to the invention;

[0014]

Figure 1c, another side view of the testing device according to the invention;

[0015]

Figure 2a, a side view of another structural variant of a testing device according to the invention;

[0016]

Figure 2b, a side view of a structural variant according to the invention from Figure 2a in another position of the testing device;

[0017]

Figure 2c, a cross section of the testing device according to Figure 2b.

[0018]

Figure 1a shows an oblique view of a testing device 1 according to the invention for simulating rear-end collisions (servo-hydraulic catapult system). The testing device 1 is further shown in Figures 1b and 1c in side views in different positions.

[0019]

The testing device 1 has essentially a rail arrangement 2, which consists of two parallel rail elements 3 spaced apart from each other in the horizontal direction (x-direction) [sic; y direction]. The coordinate system K shown for Figure 1a defines the x, y, and z directions.

[0020]

The rail elements 3 are each mounted on a foundation section 4 extending in the x-direction and projecting upwards in the vertical direction. A first sled arrangement, which is formed as a base sled 5, is guided in a sliding manner on the rail arrangement 2. For this purpose, the rail elements 3 are formed in cross section as an I-profile. The base sled 5 has side elements 6 that each grip the rail profile 7, which guarantees a defined guidance in the x-direction.

[0021]

The base sled 5 has on each side of one of its end regions a triangular plate 8, extending in the z-direction. The two plates 8 are spaced apart from each other in the y-direction.

[0022]

The testing device 1 further consists of a second sled arrangement which is formed as a carrier sled 9.

[0023]

The carrier sled 9 is arranged above the base sled 5, spaced apart from it in the z-direction, and essentially consists of a rectangular base plate 10 with rectangular recesses. The carrier sled 9 has, on its side facing the base sled 5, a triangular plate 11 extending in the z-direction. The base sled 5 and carrier sled 9 are hinged together by means of two elongated connecting elements 12. For this purpose, the connecting elements 12 are rotatably seated at one end region in the plate 11 connected to the carrier sled 9 and, at the other end region, are seated in the plate 8 connected to the base sled 5 so that they can rotate about the y-axis. Due to this coupling, longitudinal forces can be transferred from the base sled 5 to the carrier sled 9.

[0024]

The support and bearing of the carrier sled 9 is realized by means of a first acceleration unit 13 that consists of four hydraulic cylinders 14. Here, two hydraulic cylinders are arranged on each side on a foundation and spaced apart in the x-direction next to the foundation section 4. The hydraulic cylinders 14 are each aligned in the z-direction, with the piston rod 15 of the hydraulic cylinder that projects from one end pointing upwards in the z-direction. The hydraulic cylinders, spaced apart in the x-direction, are both arranged on one foundation section 4 on the side and articulate with their piston-rod ends to an elongated guidance rail 16. These two guidance rails 16 extend essentially in the x-direction parallel to each other. The guidance rails 16 are arranged to the side of, and above in the z-direction, the rail elements 3 that are adjacent to the guidance rails. The guidance rails 16 extend essentially in the x-direction and have an I-profile in cross section.

[0025]

The carrier sled 9 has on each side two guidance elements 17 which can each grip the guidance rails 16 arranged to the side. As can be seen from Figure 1a, only the guidance elements 17 arranged in the front region of the carrier sled 9 grip the lateral guidance rails 16. This configuration described above realizes a support and sliding bearing of the carrier sled 9 on the guidance rails 16 connected to the hydraulic cylinders 14.

[0026]

Not shown is the test assembly, which is fixed to the carrier sled 9 before a test sequence for crash simulation. In general, the test assembly consists of a reinforced vehicle chassis with vehicle components to be tested, such as seats, steering-wheel columns, steering wheels, windshields, dashboards, safety belts and attachments, airbag systems, as well as a dummy. As already explained in the introduction of the description, testing devices according to the state of the art operate with so-called inverse crash tests, i.e., deceleration in the forward movement occurring in a real motor vehicle collision is converted into an acceleration, with the test assembly being moved backwards (x-direction). The acceleration is here applied by a second acceleration unit, also not shown, which is controlled according to the desired value stored in a control device.

[0027]

The second acceleration unit consists of a servo-cylinder as a regulating element with pistons and piston rods supported so that they can move in the z-direction. The servo-cylinder is here controlled by a multi-stage servo-valve that connects to a piston-type accumulator unit. The

acceleration is transferred according to a set-value specification through the piston, which is supported in the servo-cylinder so that it can move in the x-direction and which has piston rods guided outwards, to the base sled 5. This is indicated by the arrow 18. The carrier sled 9 with test assembly, which is coupled to the base sled 5 by means of the connecting elements 12, is then accelerated corresponding to the introduced acceleration along the rail arrangement 3, i.e., in a horizontal plane. The carrier sled 9 is here accelerated along the guidance rails 16 uniformly.

[0028]

In addition to the acceleration introduced in the direction of the x-axis, the four hydraulic cylinders 14, which are connected to the carrier sled 9 by means of the piston rods at the corresponding bearing points, as well as at the guidance rails, can also be controlled. Thus, acceleration forces can be introduced in the direction of the z-axis. Here, a so-called pitching motion of the vehicle in a real collision, i.e., a rotational movement of the vehicle about the y-axis, can be simulated by a test sequence. In order to achieve this, the hydraulic cylinders are controlled similarly. According to the control, i.e., according to a generated set-value specification, any arbitrary combination of translational movement in the z-direction and rotational movement about the y-axis can be applied. At the end of the test sequence, the guidance elements 17 arranged in the rear region of the carrier sled 9 separate from the guidance rails 16. This is shown in Figure 1a.

[0029]

In Figure 1b, the carrier sled 9 is shown in a horizontal position. Figure 1c shows the carrier sled 9 in a position tilted about the y-axis. For the test sequence, the acceleration forces are measured by means of a corresponding sensor on the sled arrangements and supplied to a control device. The control device then compares the measured actual acceleration profile with the preset desired acceleration profile. A new set value is generated after taking into account any deviation between the desired and actual values. Also not shown is the dual-circuit brake system on the sled arrangement as well as the return motion unit, which returns the sled arrangement to the original position after the test sequence. Also not shown is the emergency brake system arranged on the rail arrangement.

[0030]

As additional devices, high-speed cameras, an illumination system, and an additional brake for the simulation of a side impact can also be provided.

[0031]

Another embodiment of the testing device according to the invention is shown in Figures 2a, 2b, 2c. Here, similar parts already described are provided with the same reference symbols. In the following description, only the differences from the testing device shown in Figures 1a, 1b and 1c are described.

[0032]

For the testing device 20 shown schematically in Figures 2a, 2b, 2c, the guidance rails 21 arranged at the side are each divided in two. Through this configuration, a total of four guidance rails 21 are provided, with one guidance rail 21 being allocated to each hydraulic cylinder 14. Here, Figure 2a shows the carrier sled 9 in a horizontal position. Here, the guidance rails 21 lie in a horizontal plane, with the two guidance rails 21, which are arranged at the side on a foundation section, extending flush against each other in the x-direction. Figure 2b shows the carrier sled 9 in a position tilted about the y-axis. The schematic representation of Figure 2b shows that the hydraulic cylinders 14 are controlled such that the piston rods 15 of the front hydraulic cylinder 14 are extended farther than the piston rods 15 of the rear hydraulic cylinder 14. The guidance rails 21 of the front hydraulic cylinders 14 connected to the piston-rod ends are here brought into a higher position in the z-direction than the guidance rails 21 of the rear hydraulic cylinders 14, so that the carrier sled 9 supported in the guidance rails 21 is tilted. From the figure, it can be seen that the guidance rails 21 remain in a horizontal position in each position.

Claims

1. Testing device for motor vehicle crash simulation, with first and second sled arrangements that are arranged one on top of the other, are hinged together, and can move horizontally along a rail arrangement; a test assembly arranged on the second sled arrangement with the vehicle components to be tested; a first acceleration unit, that can transfer the preset acceleration forces in the y-direction [sic; z-direction] to the second sled arrangement; and a second acceleration unit that can transfer the preset acceleration in the x-direction to the sled arrangement, characterized in that the first acceleration unit (13) is supported exclusively between a foundation and the second sled arrangement (9).

2. Testing device for motor vehicle crash simulation according to Claim 1, wherein the second acceleration unit includes a controllable hydraulic cylinder, and the first acceleration unit (13) includes four controllable hydraulic cylinders (14), wherein these four hydraulic cylinders (14) are respectively arranged in pairs to the sides adjacent to the foundation section (4) and are spaced apart in the x-direction.

3. Testing device for motor vehicle crash simulation according to Claim 1 or 2, wherein the first sled arrangement consists of a base sled (5) that can slide on a rail arrangement, and the second sled arrangement consists of a carrier sled (9) vertically spaced apart from, and parallel to, the first sled, and the base sled (5) and carrier sled (9) are hinged together by connecting elements (12) for transfer of longitudinal forces (x-direction).

4. Testing device according to one of the preceding claims, wherein each of the paired hydraulic cylinders (14) arranged to the side on a foundation section (4) is hinged to a guidance rail (16), and the carrier sled (9) has guidance elements (17) which grip the guidance rails (16) and which support the carrier sled (9) so that it slides.

5. Testing device according to one of the preceding claims, wherein the guidance rails are divided in two and a guidance rail (21) is allocated to each hydraulic cylinder (14).

6. Testing device according to one of the preceding claims, wherein the guidance rails (16/21) are arranged to the sides essentially in a plane with the carrier sled (9).

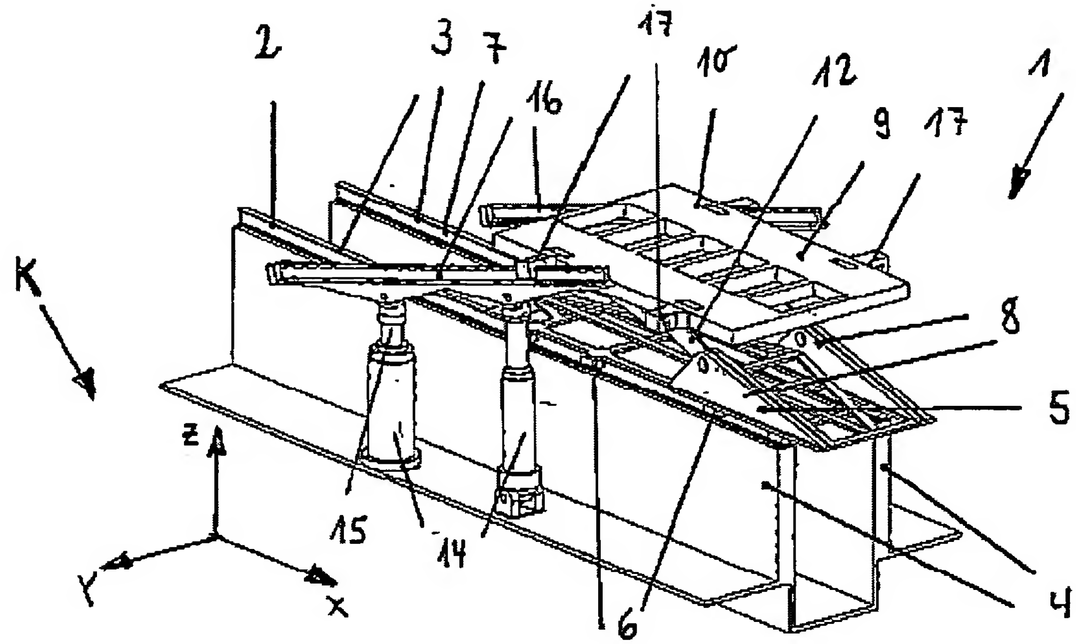

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Fig 1 a

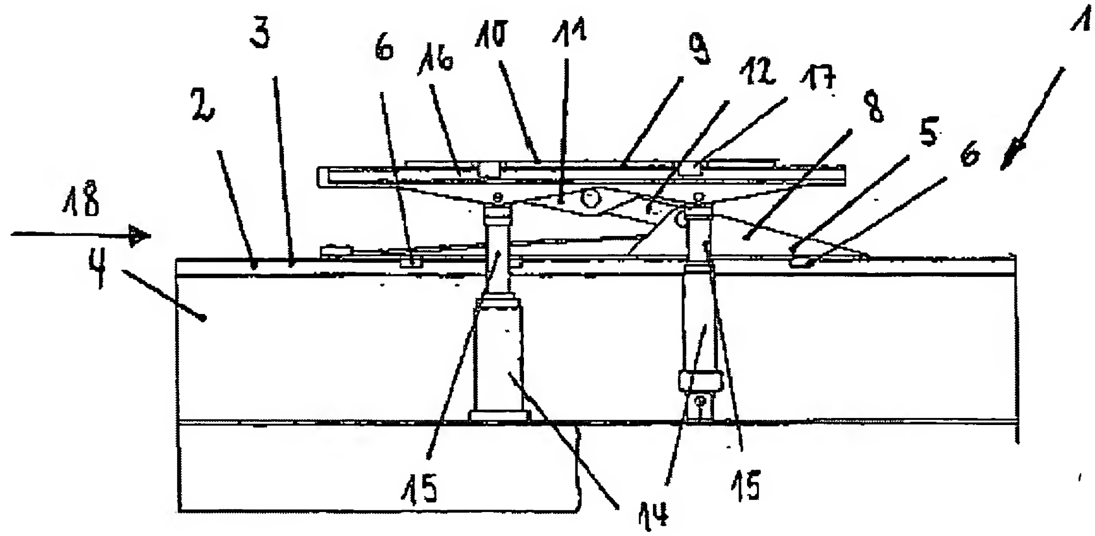
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Fig 1 b

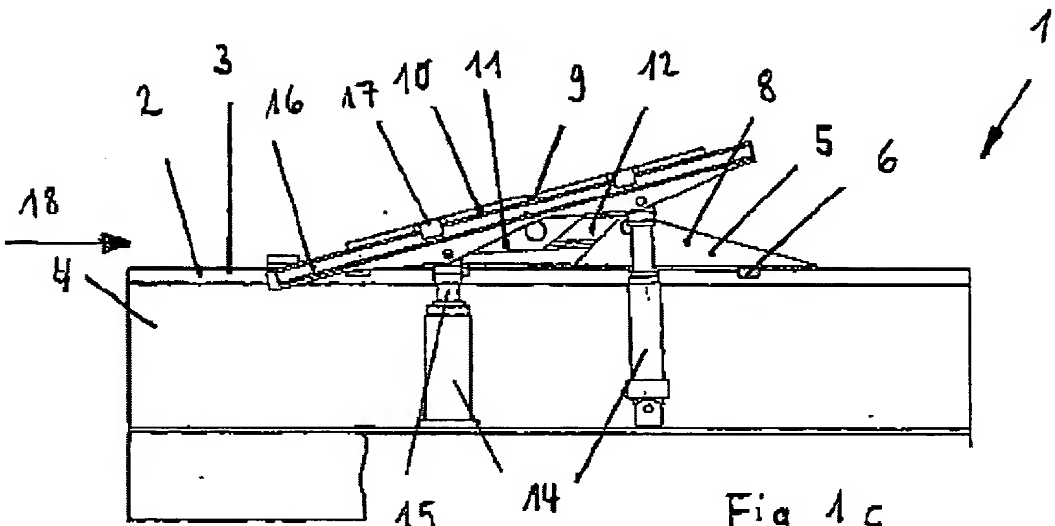
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Fig 1c

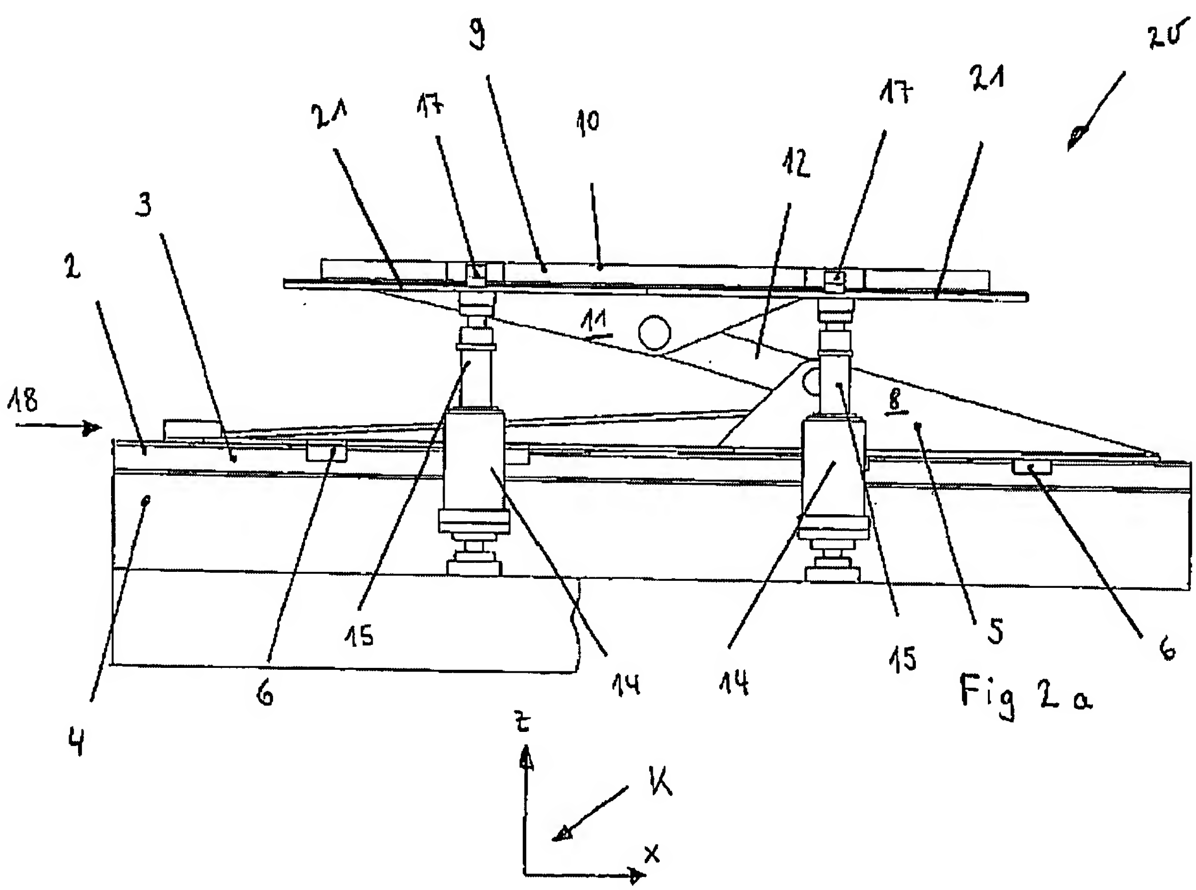
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Fig 2a

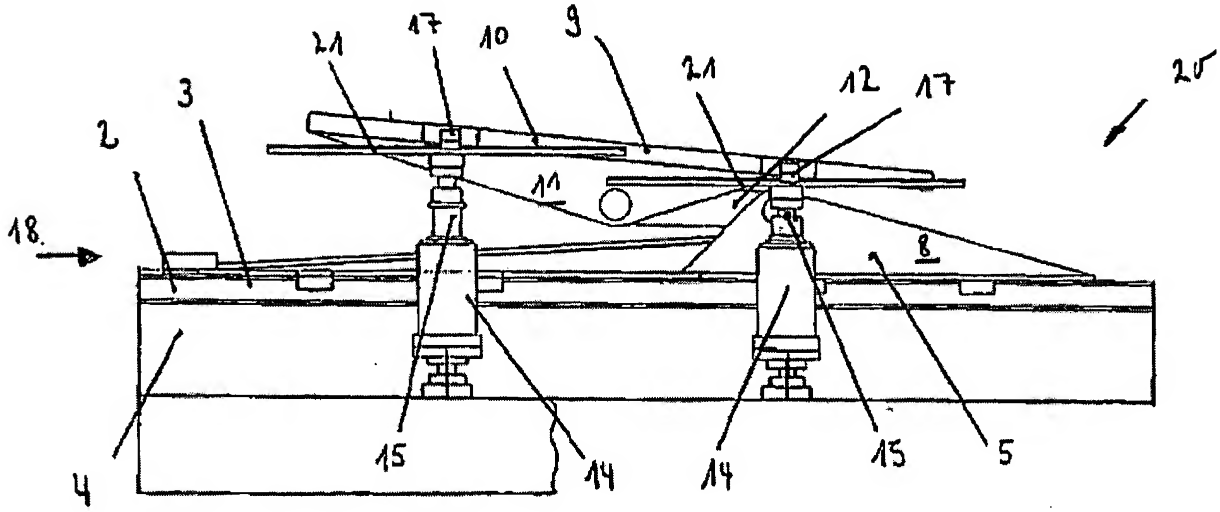

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Fig 2b

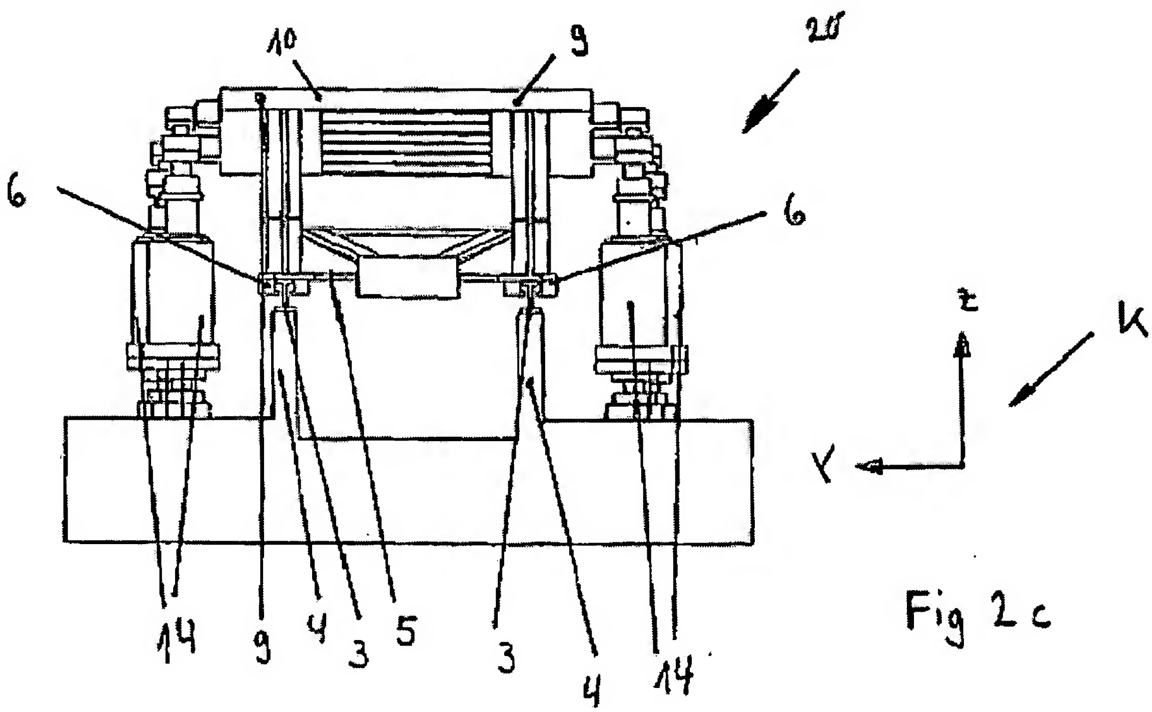

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Fig 2c